



ASHESI UNIVERSITY COLLEGE

AN ONLINE SYSTEM THAT CONNECTS FARMERS TO BUYERS

APPLIED PROJECT

B.Sc. Computer Science

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ASHESI UNIVERSITY COLLEGE

An Online System that Connects Farmers to Buyers

Applied Project

Applied Project submitted to the Department of Computer Science, Ashesi
University College in partial fulfillment of the requirements for the award of
Bachelor of Science degree in Computer Science

Francis Nabii Tiroug Yinbil

APRIL 2017

DECLARATION

I hereby declare that this applied project is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature:

.....

Candidate's Name:

.....

Date:

I hereby declare that preparation and presentation of this applied project were supervised in accordance with the guidelines on supervision of applied project laid down by Ashesi University College.

Supervisor's Signature:

.....

Supervisor's Name:

.....

Date:

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to my project supervisor, Mr. Aelaf Dafla for his dedication, commitment and guidance through the successful completion of the project.

In like manner, I would also like to appreciate my senior brother Tiroug Yinbil, my father Yinbil Spark and my mother Yapmah Yinbil for their endless and relentless support, motivation, and encouragement throughout my university program, especially through this final project.

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ABSTRACT

The introduction of agriculture technology in any country improves the annual production. Agriculture technology changes farming by reducing the amount of man power needed and increasing yield

Connecting farmers from any farming community to buyers at any place can be very challenging for both parties (farmers and buyers). Farmers after every farming season run at a loss due to lack of buyers of their farm products. Also, poor prices offered by few buyers who have been transacting business with these farmers affect them as well. Finally, the product gets spoiled when there is bumper harvest and they cannot sell all at a goal. For instance tomatoes and gardens easily get spoiled if not sold at the right time.

As a result, the essence of this project is to develop an online system that will connect the crop farmers to the buyers of their farm products. The application, therefore, considers the various challenges described above to help the farmer get the instant buyer of his or her product in order to maximize profit.

ACRONYMS

GUI – Graphic User Interface

PHP - Hypertext Preprocessor

AJAX – Asynchronous JavaScript and XML

API – Application Programming Interface

HTTP – Hypertext Transfer Protocol

ERD – Entity Relationship

EERD – Enhanced Entity Relationship Diagram

SQL – Structured Query language

JS – JavaScript

HTML - Hypertext Markup Language

CSS – Cascading Style Sheet

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Chapter 1: Introduction

1.1 Introduction

FarmerApp is an online system that connects farmers to buyers in every farming season throughout the year. The goal is to help the farmers generate maximum profits at the end of every farming season by providing them with easy accessibility to the market and also enable them to reach a large market audience. Farmers' access to quality market have been a problem and most farmers render losses at the end of harvest. The FarmerApp serves as a technological tool that solves this problem by linking farmers to the market through the platform. This help the farmers to connect to potential buyers of their products. Buyers who are registered on the platform have direct access to these farmers and their products. They are able to make informed decisions in making an order for the product.

1.2 Background – Agriculture and Agriculture Technology in Ghana

Ghana is located on the West of Africa. The country has a land of about 23.9 million of hectares. With this amount of land about 57% of it is used to cultivate crops and rear animals. That is the 57% of the land is used for agriculture purposes. Agriculture contribute to the country's economy and has been the backbone of it. Production of food crop in the agriculture sector of Ghana has reduced since 2008 from about 35.4% to 33.59%. The agriculture sector is made up of three main zones which include the Northeren Savannah zone, Forest vegetation zone and the Coastal Savanannah zone. Each of these zones produce ceratin crops and animals. For instance in the Northern Savannah zone the following crops are grown; tomatoes, cattle, sheep, goat, rice, millet, sorghum, yam, and cotton. In the coastal savannah zone the following

crops and animals are grown and rear: rice, maize, cassava, vegetables, sugar cane, mangos, and coconut as well as livestock (Agriculture in Ghana, Country Brief, 2013).

Various technologies (dissemination of market prices through mobile phones, translation of agriculture information in the local languages send as voice sms to farmers) have been developed to support the increase of production in the sector. Individuals and groups have developed marketing technologies to help farmers gain access to good market that would earn them a valuable income at the end of every farming season. Esoko Ghana is a well know agriculture technology tool used by farmers to access good market price and weather information. They send text message (SMS) to farmers on the market prices on various farm product across the country for the farmers to make informed decisions.

1.3 Problem Description & Motivation

The process of connecting farmers (especially small scale farmers) to buyers of their farm produce has been a challenge in the agriculture sector in developing countries. There is no ready market for farmers. Farmers who produced in large quantity make losses because they lack access to markets, hence their produce get spoiled. These farmers also lack access to technological tools that would give them information about the current market prices and where to locate buyers of their farm produce. Lack of these agriculture technological tools result in the farmers not been able to access information about the prices and are therefore not able to make good bargain of their products in due season. (Baumüller, 2015).

Grameen Foundation stated that a large number of people of about 2 billion survive on smallholder farming. Yet among this number, many poor farmers have limited or no access to information and capital that will improve their livelihoods (Agriculture , 2016).

In another research by Maputsoe, it is noted that Ghanaian women who dominate in the marketing of agriculture product had challenges with transporting the commodities from

production areas to the markets. There is a poor linkage between rural production areas and the markets, poor road conditions, unreliable and costly transportation; inadequate market facilities and operational capital. All these constraints put excessive pressure on women's ability to supply and meet the demands of the consumers (Maputsoe, 1998). The inability of farmers to sell their farm products add to losses they make every season of farming. Many farmers invest a significant portion of what they have during production but return the little amount of profit as a result of lack of proper connectivity and access to buyers. This reduces further the amount of resources they can invest in the next farming season.

The motivation of the project came as a result of the challenges farmers faced in producing food crops and not making maximum profit from it as a result of their inability to locate buyers (Wholesalers, retailers, and consumers) for their products on time. Farmers do not get direct link to potential buyers their products after every harvest. Farmers who plant tomatoes, garden eggs and the like, mostly make losses as a result of lack of buyers. For instance when the fruits are riped and a buyer cannot be found at that season, the fruits get rotten and the farmers do not make profit.

An online system that connect farmers to buyers (Wholesalers, retailers, and consumers) of farm product at the appropriate time to help the farmers make maximum profit.

1.4 Related Work and Existing Solution

The process of connecting farmers to buyers of their farm product has been a challenge in the agriculture sector in developing countries (Baumüller, 2015). Most farmers in rural areas of developing countries do not have access to agriculture technologies. They also do not have access to market information. Most of these problem can be attributed to lack of modern agriculture technologies. This in turn affects the market involvement of most market women and consumers. Farmers also lack information about prices, the real demand in markets of different

kind and lack connections to buyers (Baumüller, 2015). This, therefore, limits farmers to access the market and its daily offers. As such, they are exposed to few buyers which do not buy their products at a good price.

Participatory Market Research is a common way of linking farmers within the rural areas to make them active in selecting opportunities that comes their ways. An element for the success of this kind of method is that those farmers involved must have a common goal and visions to enable them become part of the research market(Sanginga, et al., 2004).

Linking Local Learners is also another common way of linking farmers which enables farmers of small scale and processors within the rural areas to learn on how to build a market that would be profitable to them and that of the consumers. This technique permits farmers gather information and data from the market and inform their colleagues about the current market prices of the various products they produce. This Linking Local learner method eliminate cheating on the market chains. By doing this it ensures efficiency of marketing and transportation of farm product to a large market efficiently and profitably (Lightfoot, Gilman, Scheuermeier, & Nyimbo, 2008).

A technological means of connecting farmers to buyers have been developed by individuals and organizations. They have tried to improve the conditions of farmers by collecting data about current market price and given it to the farmers before they go into the market to sell their product. Others have developed applications to send SMS to farmers with current market prices. Few examples of such systems or individuals or organizations that tried to help farmers get access to market information are Esoko Ghana, Manobi in Senegal, LINKS-Tanzania, KACE-Kenya and M-Farm Kenya.

Esoko Ghana is a private company operating in Accra, Ghana. It has both mobile and web applications that are used to collect and disseminate to farmers. Esoko Ghana provides a platform where organization and individuals can get data for agricultural purposes.

Manobi is a company based in Senegal. It has both mobile and web-based tools that are used to send information about market prices to farmers.

LINKS is a Tanzanian company. It is operating in Tanzania, Kenya, and Ethiopia. LINKS stands for Livestock Information Network Knowledge System. It is used to help monitors prices of livestock transactions as well as provides information on the breed, age, gender, and grade.

KACE is another company in Kenya. It stands for Kenya Agricultural Commodity Exchange Limited. The company provides up-to-date market information that is useful to farmers

M-Farm is a company based in Kenya. It is a tool use to send text messages to farmers about market prices.

These related works indicate that much work needs to be done to improve the conditions of most farmers by linking them directly to buyers. These buyers can be categories into many groups. They are included in the requirement plans in chapter two of this document.

1.5 Aims and Objectives

The FarmerApp is developed to suit both mobile and web application approaches. FarmerApp will work on both mobile and web platforms. The application serves as a tool that helps farmers and buyers connect to one another to facilitate smooth business transaction in order for the farmer to make maximum profit at the end of the farming season. It helps the farmers get connected to buyers across different districts and locations without having to wait until the products get rotten. This project allows buyers to be efficiently linked to the farmers without

having to travel all the way to the location of the farmers in order to be certified with the farmers' products. The FarmerApp application has two different views for both farmers and buyers. This enables the farmers and buyers have access to specific data and information. For instance, an information that would be seen by the farmers would be the buyers' types and the price they are willing to pay for the farmers' produce as well as the location of the buyers. In the buyers view they would be seeing the farmer, his products, location as well as the price of the produce.

Following are the principal objectives of this project:

- Connect farmers to buyers
- Find market for farmers
- Maximize farmers profit
- Encourage the youth into agriculture by providing them with a portable tool that they can used to sell their produce at the end of harvest.

1.6 Overview Description of Report

This gives an order structure of the report to help the end users use the system more efficiently effectively.

The first chapter revealed the essence of the report as described above.

Chapter 2 describes the procedure followed to gather the requirement in detail.

Chapter 3 describes the architecture and design of the project. It includes the design interfaces and the system modules as well.

Chapter 4 includes the implementation and testing of the entire software. It provides the main task undertaking by eac of the users of the system. It also provides libraries and tools that would be used to support the system development of the project. It describes the functional and non

functional requirements of the application. Also in this chapter different types of testing are used to test the features implemented to meet the desired software required.

The final chapter which is chapter 6 describes the summary of the entire work. It includes the challenges encountered during the course of the project as well as the limitations of the project. It ends with recommendations to allow future continuation of the project.

Chapter 2: Requirements

Gathering of the requirements were uniquely identified and understood. This created an excellent path for the successful progress of the project to be executed. The author took a step to gather the requirements from individuals to enable the development of the application. Farmers and buyers were interviewed. Agricultural analysts were involved in various discussion to understand and gather good requirements for the project.

2.1 Requirement Design Overview

A detailed layout of the requirement plan were put in place to. This enabled the author to develop interview questions for the farmers and buyers. The plan served as a guide compiling the author to meet the agricultural analyst and supervisor. Both personalities were helpful in ensuring a successful execution.

Table 1: Requirement design Overview

Resource	Information	Method
Farmers	What will it require farmers to connect directly with the buyers of the farm product?	Open-ended interviews
Processors	How will they be linked to farmers for the farm product desired by them?	Interviews
Market women	How will they be linked to farmers for the farm product desired by them? What features do the market women need to easy their usage? What quantity of produce do they need from the farmers?	Open-ended interviews

Food Distributors	How will they have access to the farmers and the farm product needed for their companies?	Interviews
Agricultural analyst	Is there a way the analyst can help in the connection of the consumer (Buyers) to the producers (Farmers) as well as the Developers?	Open discussions
Supervisor	What guidelines can you give to the students to execute the project successfully.	Scheduled meetings, research and discussions as well as advice to the student.

2.2 Interview

From the requirement plan stated above, interviews were taken on five farmers and five buyers. Five farmers from Berekuso in the Eastern Region of Ghana were interviewed on how they get buyers to buy their products after every farming season. They were also interviewed on the price they are willing to sell, the quantity of production, the quality of their product, the location of the farm as well the mode of money transaction they were familiar with. The interviews were also to find out what they expect from buyers. At the end of the interviews, the report indicated that farmers would prefer buyers who buy their product at the good price and are always available at the right time when the goods are ready. The report indicates that the farmers would prefer direct link or connection between them and that of the buyers in order for them to be able to produce large quantity of farm produce desired by the buyers. They also preferred proximity buyers. That is the buyers who are near to them so that they would not have to travel all round looking for buyers of their farm products.

On the other hand, the buyers' interviewed were five markets women in the Dome market of the Greater Accra Region of Ghana to know what exactly they are looking for from farmers in order to buy their products. Based on that, most buyers indicated that they prefer quality, good price and desired quantity of products the farmers can offer them at the end of the farming seasons. They also expressed interest in the proximity of the farmers as this may cut down the cost in travelling to buy farm products.

Application Overview

The FarmerApp is available to help connect farmers to buyers. The application is expected to link a specific farmer to the specific buyer of his or her farm product. For instance, when a pineapple farmer signup and upload his/her product on the platform, it should link him to pineapple buyers on the platform. The figure below indicates the entirety, systems and how they interact together.

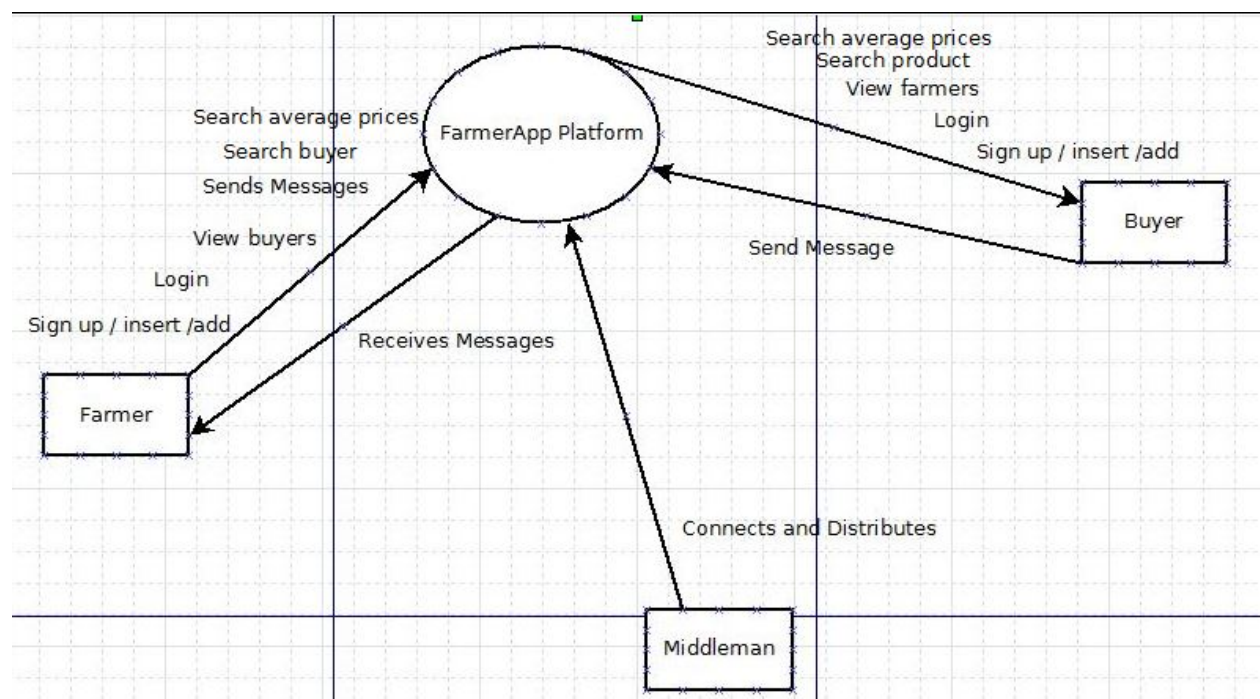


Figure 2.1: Interaction among farmer, buyer and middleman (context-diagram)

2.3 Application Feature

The FarmerApp allows the farmers and buyers to create their own accounts and use it at any time. Upon account creations the users can view, search and order for product or send message to the desired customers on the platform. If the buyers make order SMS is sent to the farmer about his product been orderd. The FarmerApp provides both mobile and web usage. This enable the users of the platform to have access to it at any point in time.

2.4 User Classes and Characteristics

The principal users of the FarmerApp system are farmers and buyers. Farmers perform diverse tasks including signing up for the first time, uploading or inserting their farm produce, viewing the buyers on the system, sending a message to the buyers and updating their products' information. They can search for buyers on the platform as well as search for the average prices of product in order to price their own product well. Buyers as the second major users of the systems sign up, view farmers, place an order and negotiate with the farmer on the platform. Buyers can search for farmers by location or product name. They can search for average prices of various products on the platform based on regional markets. For instance, a buyer can enter a product named cassava and region say Greater Accra. The average market prices of the cassava product would be displayed for all the markets in Greater Accra.

2.5 Operating Environment

The FarmerApp works on both mobile and web application. The web application which is developed now can be converted to the mobile application. The mobile version is a hybrid application hence it works on IOS, Android, and Windows. It has multiple browsers support which include Google Chrome and Firefox. The web application uses PHP, JS, HTML and

CSS. Both mobile and web platforms enables the easy usage of the FarmerApp by the users (Farmers and Buyers).

2.6 Functional Requirement

In this system various use case diagrams are used to practically display the functional requirements.

2.6.1 First User-Type: Farmers

The use case diagram below indicates the farmer and all the major tasks the farmer can perform to meet his or her needs on the platform.

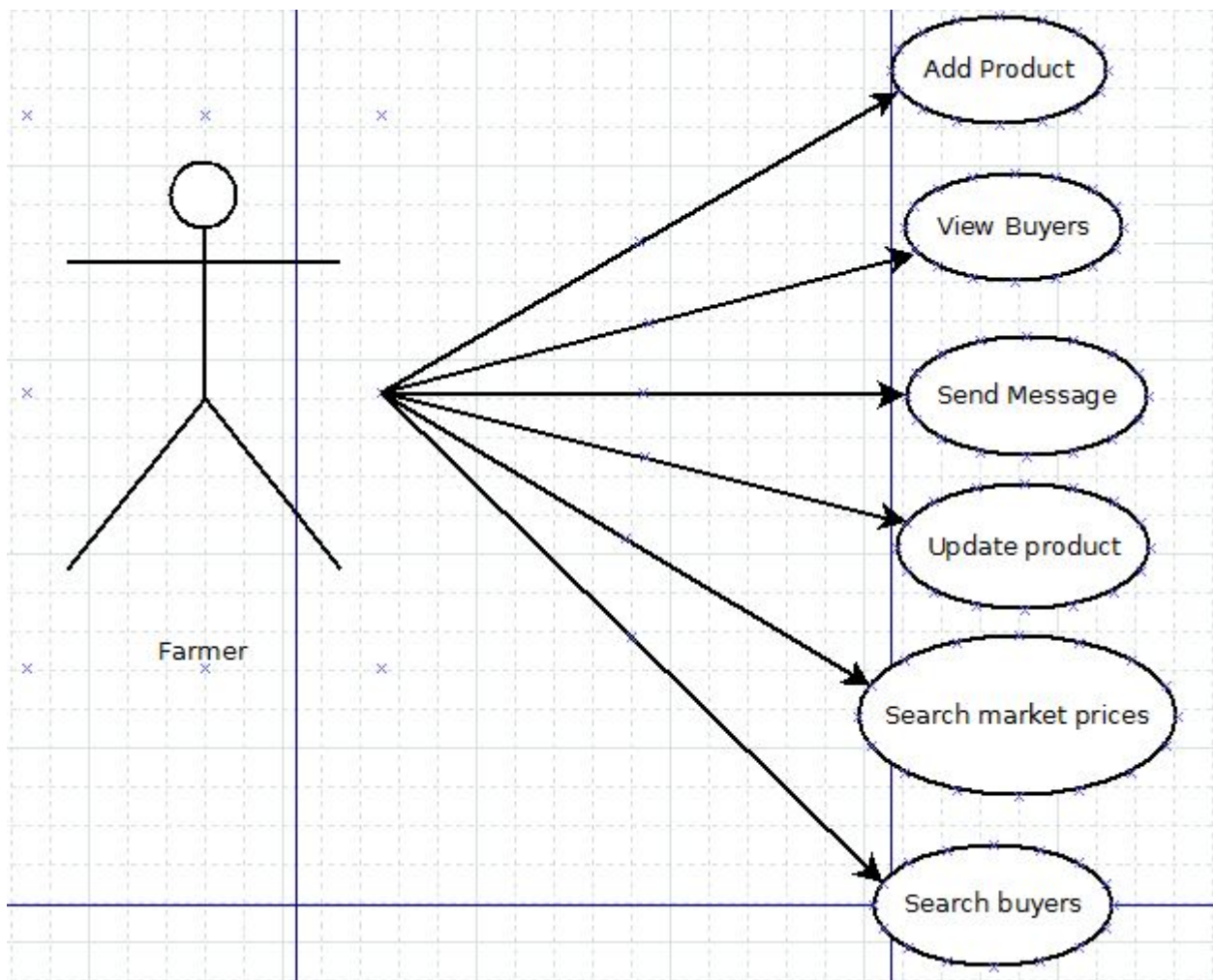


Figure 2.2: Farmers' use case diagram

The following are the principal requirements for the farmer:

➤ **Product insertion**

The farmer can insert product upon successful login if registered as a user.

➤ The farmer can **view various buyers** in the system aside those who are interested in his products.

A farmer upon successfully sign up or login should be able to view the buyers in the system.

➤ The farmer should be able to **send message (SMS or email)** to buyers upon successful inserting and sign up in the system

➤ The farmer should be able to make **update (new product)** on the platform

➤ The farmer should be able to **search** for buyers outside his or her category

➤ The farmer should be able to search for **average market prices** of the product by entering the product name and the region.

2.6.2 Second User-Type: Buyers

The use case diagram below indicates the buyer and all the major tasks the buyer can perform to meet his or her needs on the platform

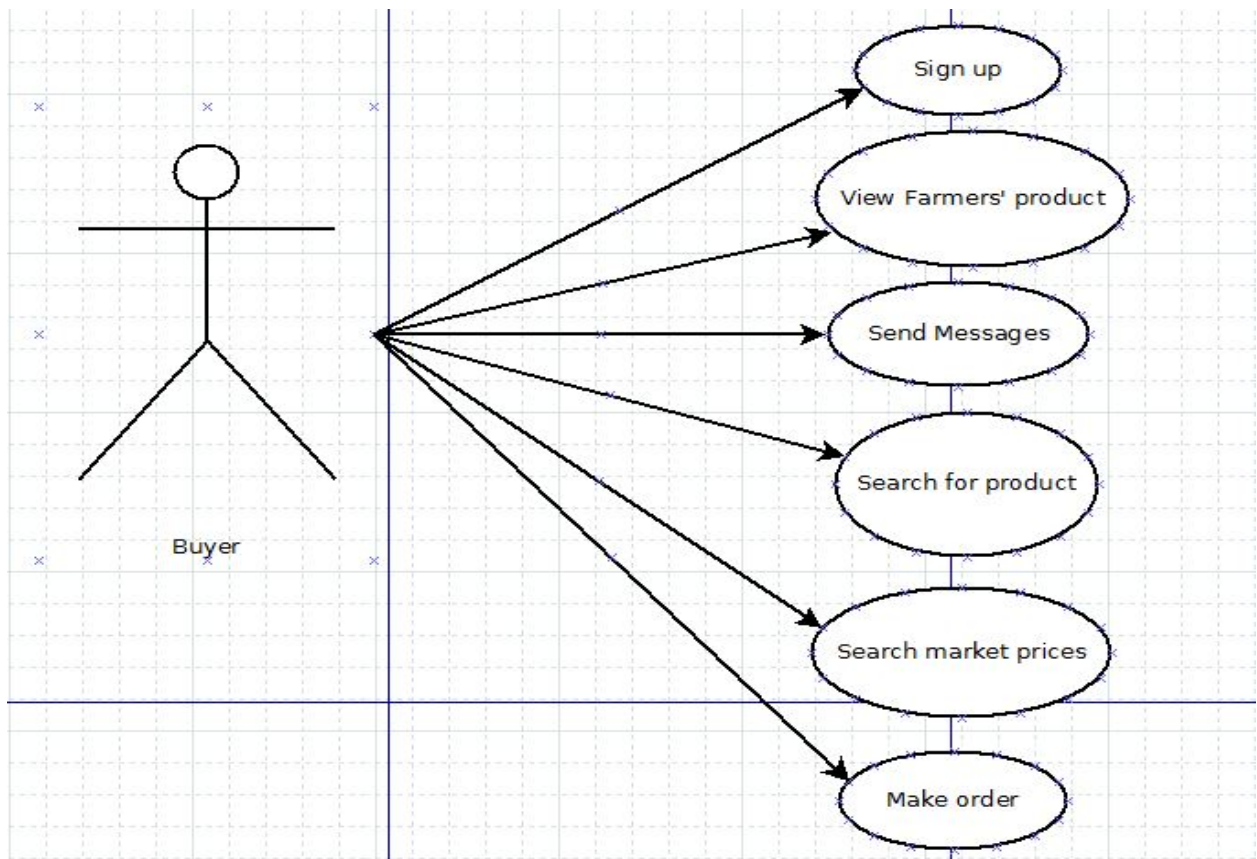


Figure 2.3: Buyers' case diagram for buyers

The main functional requirement for the buyer are as follows:

- **Sign up with his or her relevant details** on the platform
- The buyer should be able to **view various farmers** in the system aside those he or she is interested in their products after successfully sign up or login
- The buyer should be able to send message to farmers upon showing interest in the farmer's product
- The buyer should be able to search for farmers on the platform
- The buyer should be able to place order on the product he or she is interested
- Buyers should be able to search or view prices of various products across markets in any region within the country.

2.7 Non-Functional Requirement

2.7.1 Product Requirements

This subsection of the non functional requirements gives the users of the platform an understanding of the FarmerApp application. It comprises of security, reliability and safety and performance of the application.

2.7.1.1 Security

The system must keep farmers and buyers details as secured as possible. Information retrieved from the buyers and farmers should only be used for the purpose of a business transaction on the platform and kept confidentially. Also, the FarmerApp must operate based on an identification requirement systems to confirm the legitimacy of the farmer and the buye.

2.7.1.2 Dependability

The FarmerApp system should send notification to each farmer once a buyer of that particular farmer's product signed up and showed interest in it. The buyer too should be notified once a farmer has uploaded a product related to his or her choice. The system must be available for the users to use it at any time. a component inefficiency should not cause other component to fail.

2.7.1.3 Safety and Performance

The performance of the system determines it usability by the various users. Therefore the application has to be tested to ensure that the errors arising during the usage are kept under control. Following the performance of the sytem it must also be secured enough for the users informations to be kept secured without any issues.

2.7.2 Organizational Requirements

2.7.2.1 Operational Requirement

The system does not allow restrictions on the uses of any platform. Though mobile and web, it can be accessed by the users of the application.

2.7.2.2 Ethical Requirement

The FarmerApp has a well-built database system that stores information about the farmers and buyers. This data is stored and secured every time the users use the platform. With regards to this, every farmer or buyer information and data are kept secured and confidential.

2.7.2.3 Product Regulatory Requirement

The FarmerApp system allows multiple users at a goal. As such the system must provide users permission. The permission gives some users privilege to change the information. This system has login permission for constant regulatory. The FarmerApp platform includes the ability of the system to handle bad users inputs and data as well as maintain the system when there is the need.

Chapter 3: Architecture and Design

This chapter describes the system structure, the design used, system interface, architecture, database design, data design and the various modules.

This platform uses the approach of plan-driven since the solution nor outcome is assumed to be known by the developer. As time goes by users of the systems will need to provide consistent and constructive feedback. Therefore an incremental model should be considered.

3.1 Architecture Outline

A clearly architecture of a system enables the developer to know the component that interacts with one another. This called for the use of Model, View and Controller (MVC) for the user to easily manipulate the platform.

In using the MVC, the developer will be able to debug the numerous errors in the platform. The MVC works by the database changes change, offered by the administrator. This database change is as a result of the model. When the data changes, information can be sent to the view through the controller.

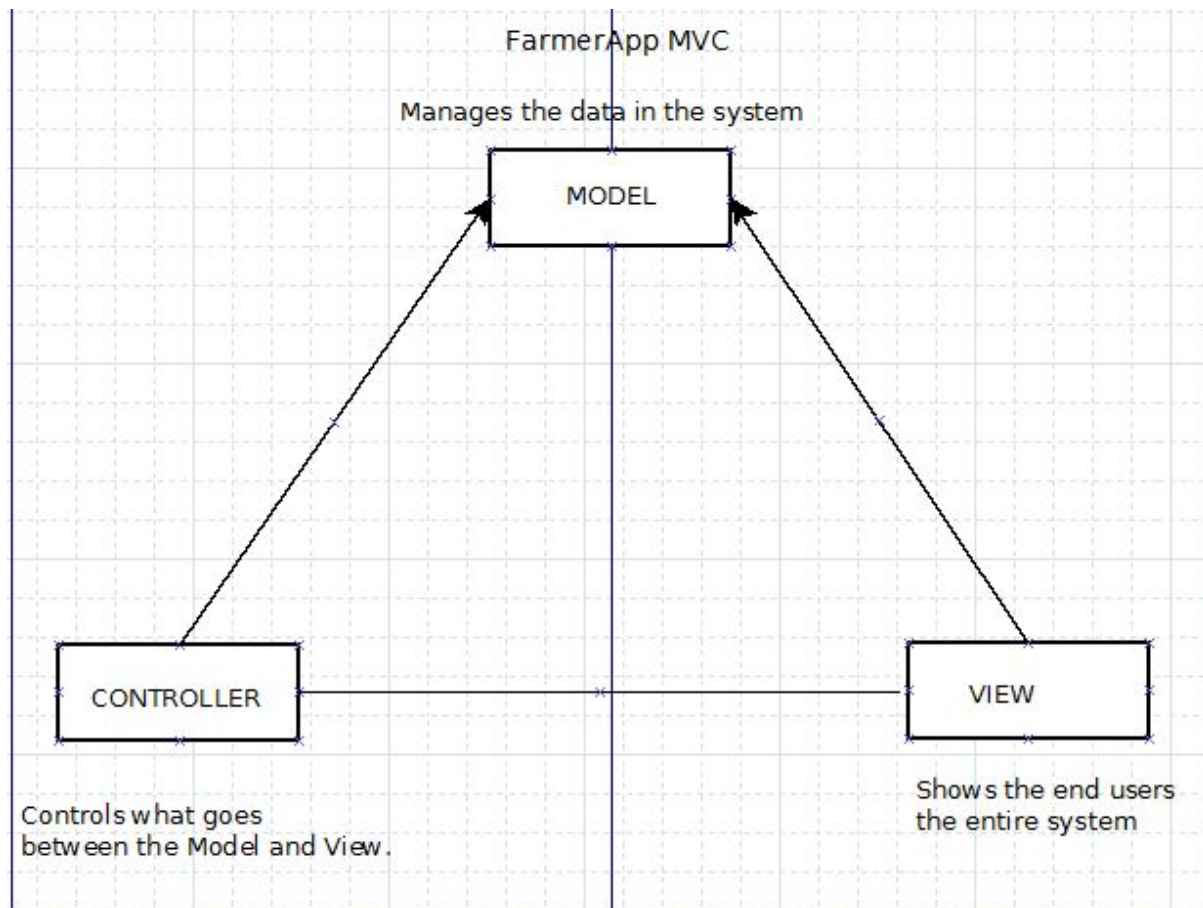


Figure 3.1:Architecture of the MVC System

3.2 Interface Design

The interface design section enables the inclusion of screen shots of the interfaces. The interfaces give guidelines to the users of the platform to easily navigate the platform using buttons and links and images provided.

The interfaces below indicate the homepages of the farmers and buyers.

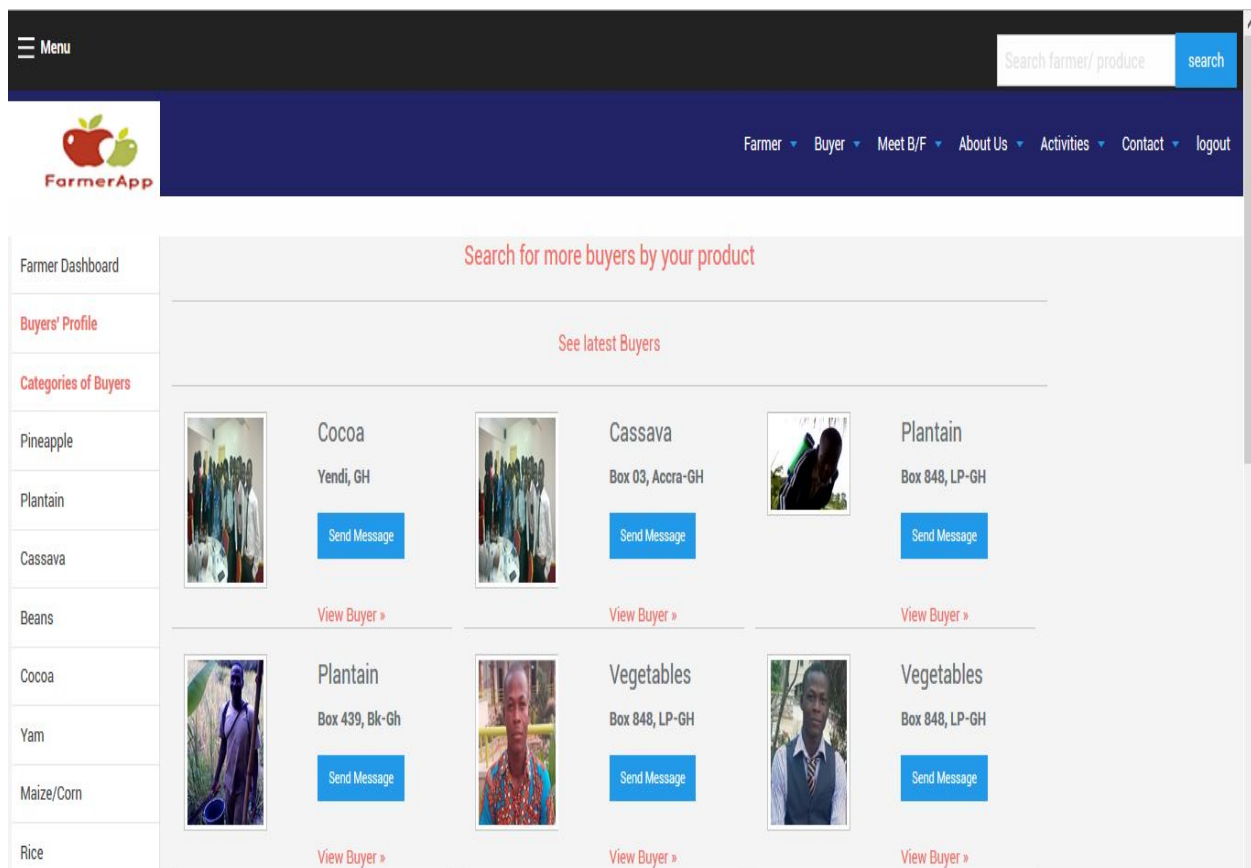


Figure 3.2: Farmers homepage

This serves as the homepage of the farmer where he or she sees the buyers of the product he or she produces. Upon first signup the farmer has the opportunity to see all the buyers of that specific product of his or her. Later on when the farmer logs in he or she sees all the buyers and the relevant details of them as shown above.

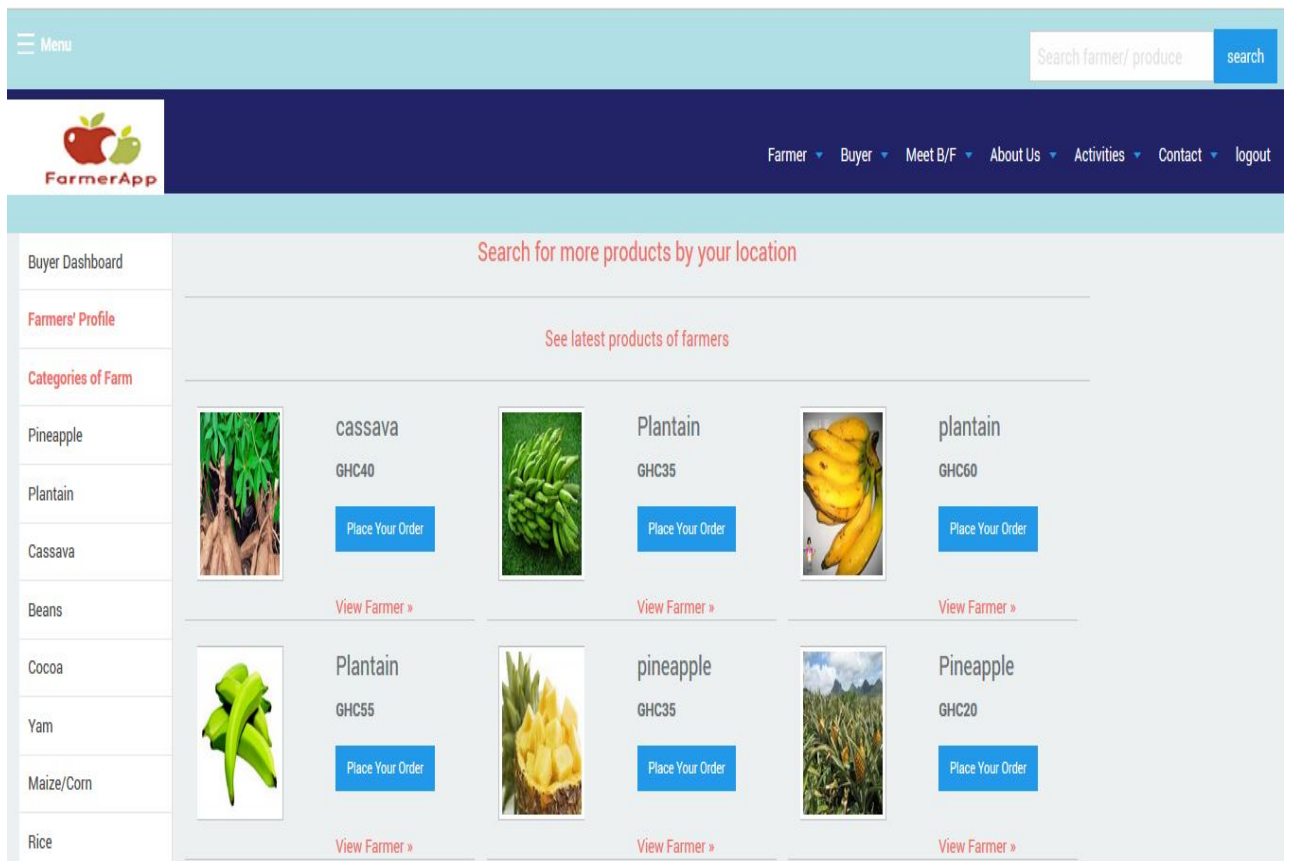


Figure 3.3: Buyer homepage

This serves as the homepage of the buyers where they see the farmers' product. Upon first signup the buyers have the opportunity to see the specific farmers' product of their choice. Later on when the buyers login they see all the farmers and the relevant details of them as shown above.

3.3 Database Design

The FarmerApp database system comprises of major entities such as Farmers, Buyers, Middleman and Farm as well as other weak entities. It also includes data for the order and message table where orders made on the platform are stored in secured places for future usage. It has the message data to help know the number of messages sent to both buyers and farmers.

3.4 Data Design

The system data design includes an enhanced entity relationship diagram that explains how the entire system interact with each other. The figure below indicates EER diagram of the FarmerApp. It has strong entities and weak entities. In the appendices (appendix 1) there are few list of entities and their attributes.

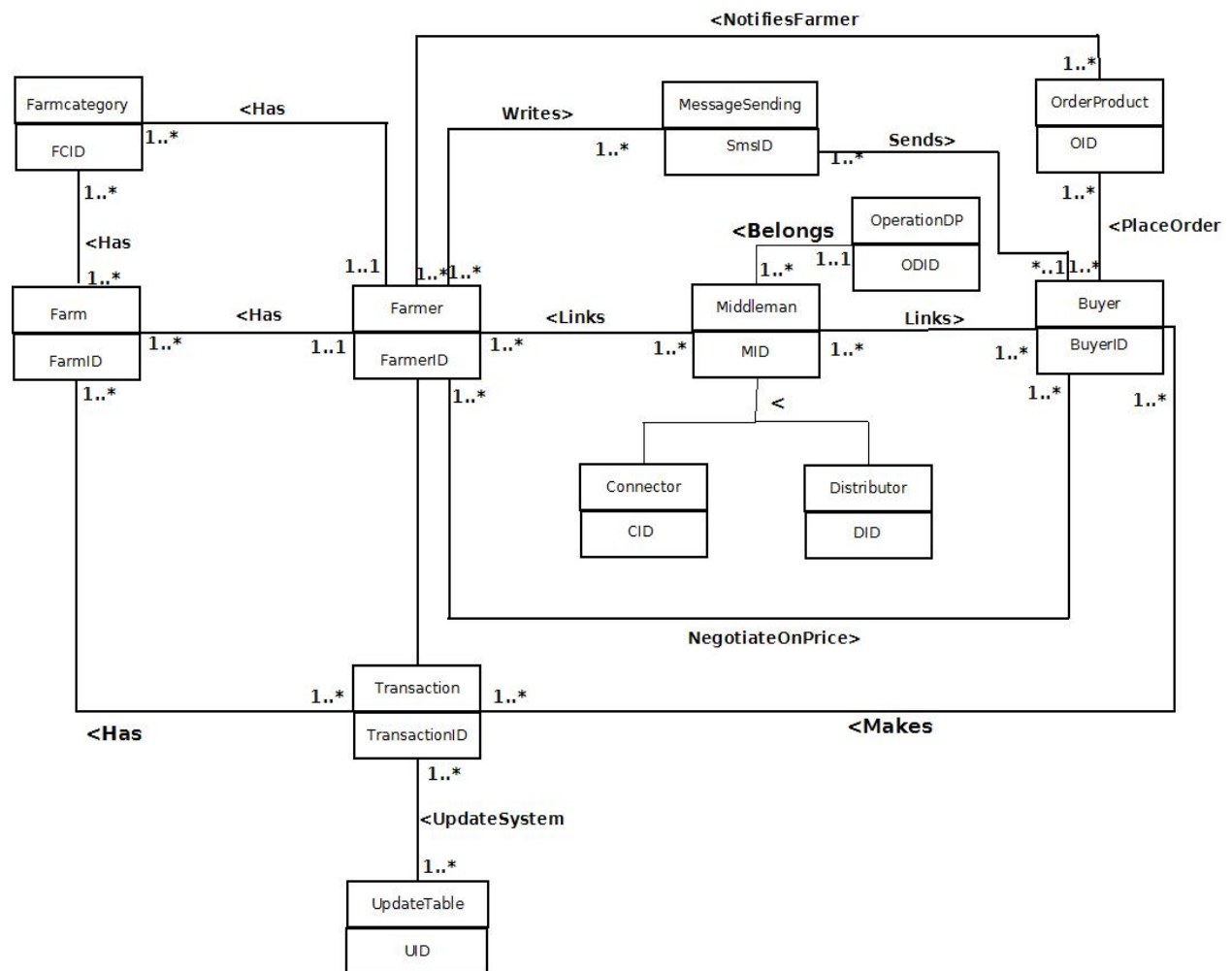


Figure 3.4: Enhanced Entity Relationship (EER) Diagram

This EER diagram indicates that one or more middlemen can link the farmers to the buyers and vice versa. It also indicates that a farmer can have one or more farm. Also, it shows the number of messages the buyers can send to the farmers when they see a product and they are interested. One message can be sent to a farmer at a time by the buyer. The transaction table shows the

farmer and the buyer who meet to buy and it includes the product type, quantity, price and the date of transactions.

3.5 System Model

The FarmerApp is made up of three modules such as the administrator's module, buyers' module and farmers' module. The buyers' module involved the major activities that are related to the buyers. The FarmerApp offers privileges to the administrators to operate on tasks such as creating accounts, updating, viewing and searching for the users on the platform. The administrator also caters for the safety, security and the availability of the systems. On the other hand, the farmers' module involved the major tasks that are related to the farmers. This farmers' module shows farmers the various buyers of their farm products and they can make an informed decision based on the given data.

The figures show the classes attached to the farmer's module

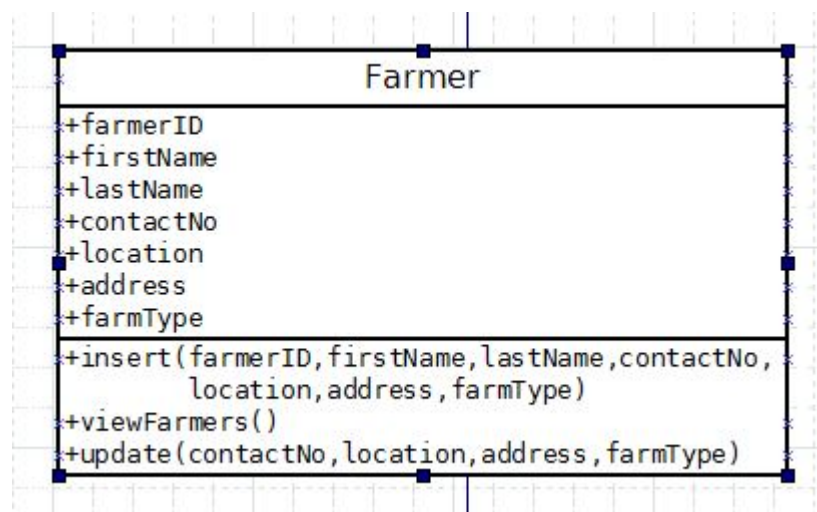


Figure 3.5: Farmer Classes

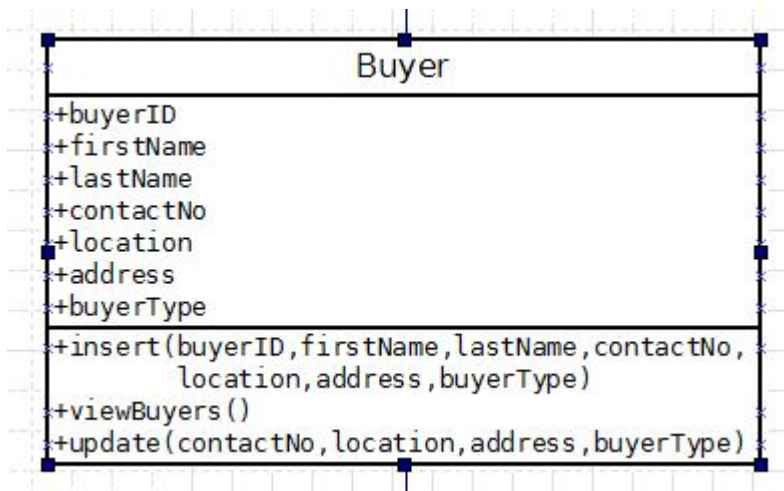


Figure 3.6: Buyer Classes

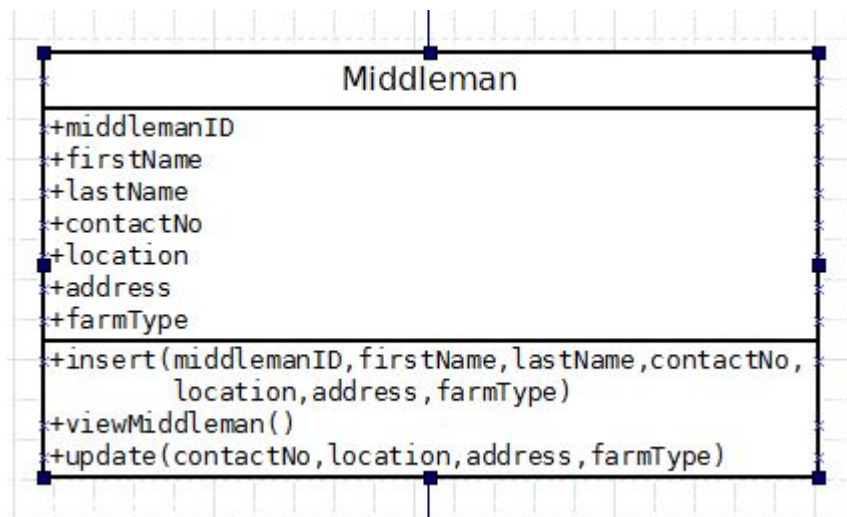


Figure 3.7: Middleman Classes

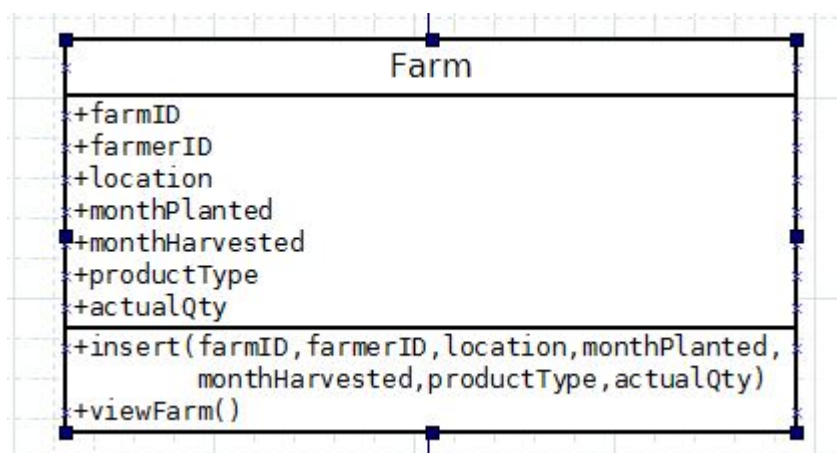


Figure 3.8: Farm Classes

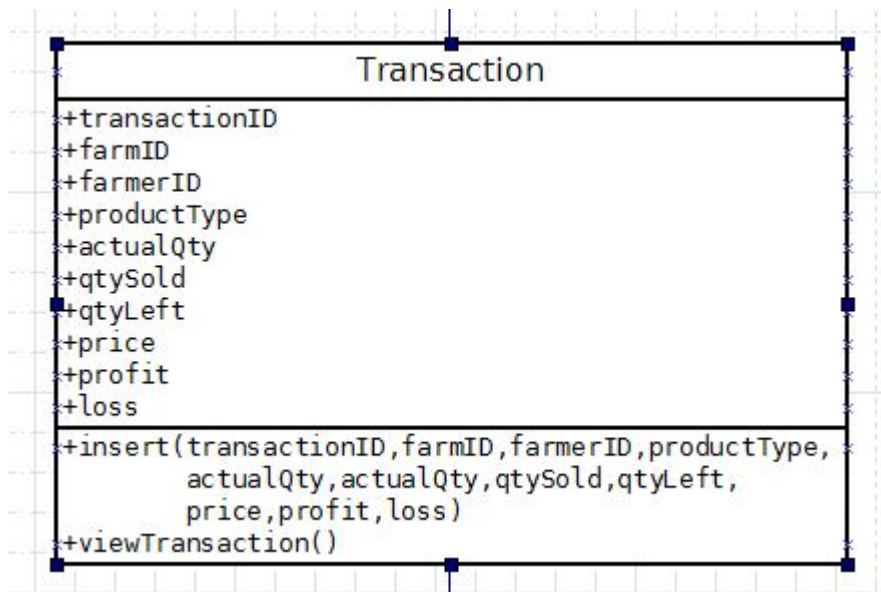


Figure 3.9: Transaction Classes

3.6 Activity Diagram

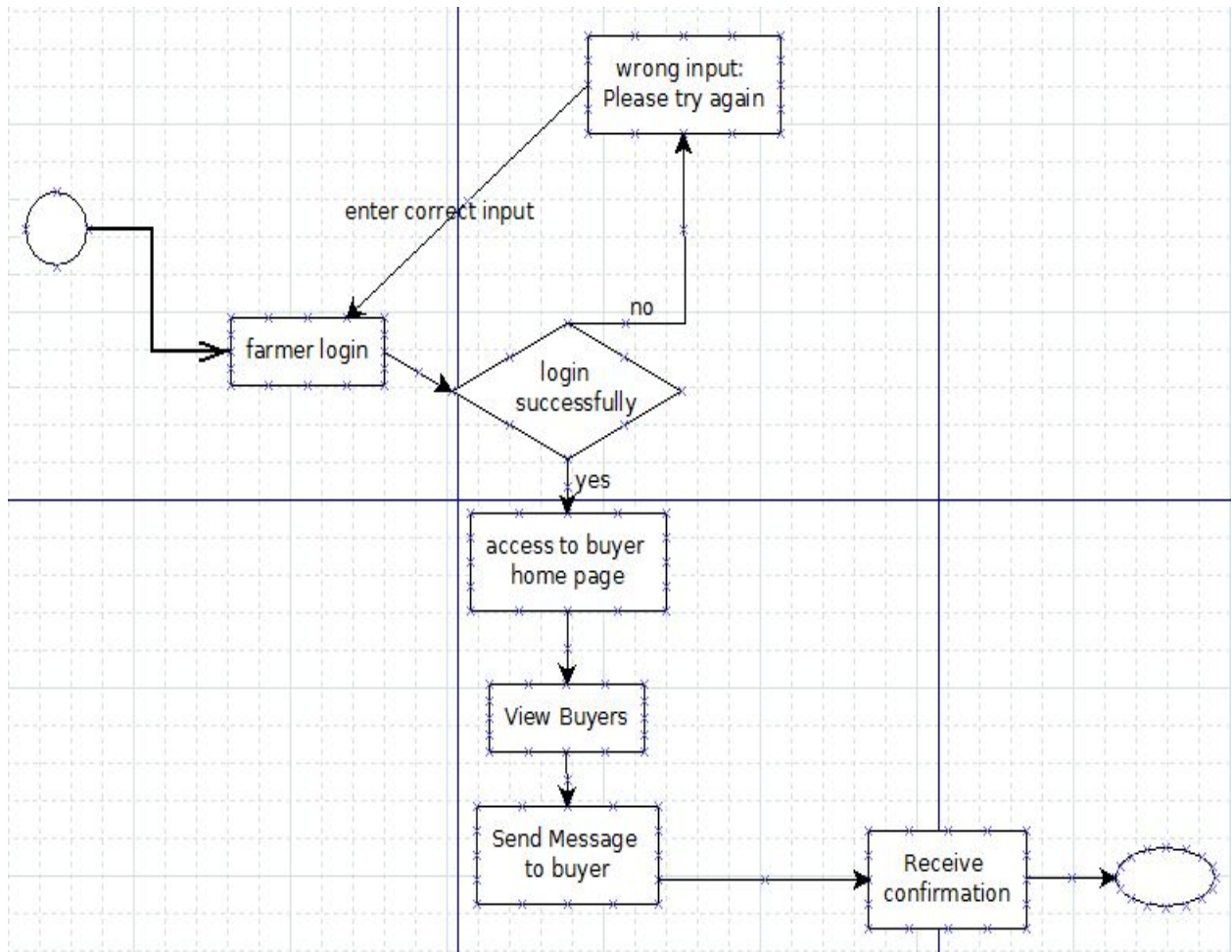


Figure 3.10: Activity diagram of Farmers

This indicates the various activities embarked by the Farmers on the platform. For instance, a Farmer who has an account can login with his or her username and password. If successfully logged in, the Farmer has access to the homepage where he or she sees all the buyers of his or her products. He can search, view and send message to buyers. Message sent successfully is confirmed at after delivery.

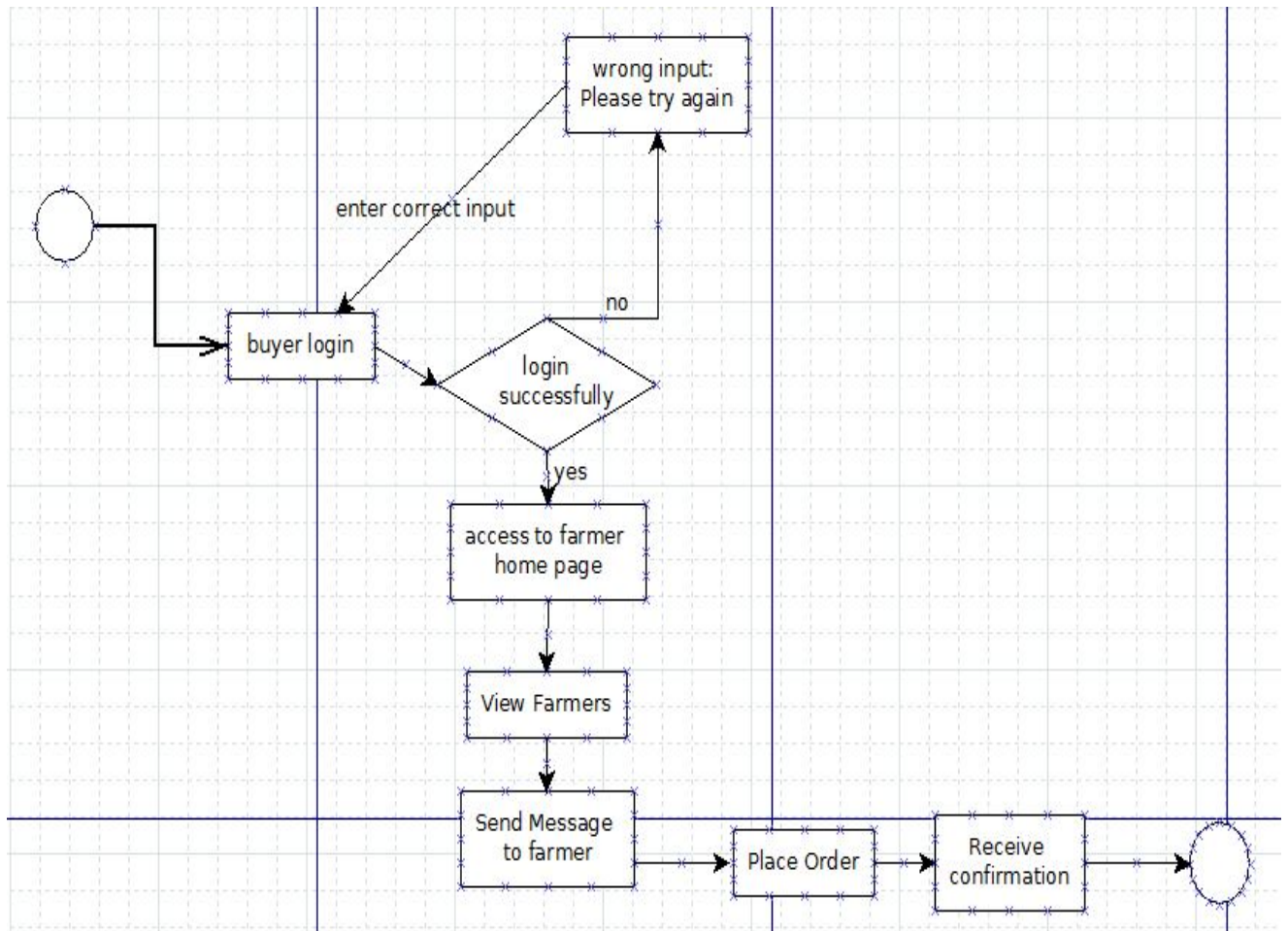


Figure 3.11: Activity diagram of Buyers

This indicates the various activities embarked by the Buyers on the platform. For instance, a Buyer who has an account can login with his or her username and password. If successfully logged in, the Buyer has access to the homepage where he or she sees all the farmers' products. He or she can search, view and send message to farmers he or she has showed interest in. Message sent successfully is confirmed at after delivery.

Chapter 4: Implementation and Testing

The implementation chapter gives summary of the system overview, its implementation support and system performance.

4.1 System Description

The platform enables several processes to ensure system supports multiple processes to ensure consistency and dependability. The farmers begin to sign up for his or her product and get connected to the buyer with the relevant information on the side of the buyer. The system provides a variety of buyers' information that can help the farmers to make an informed decision more especially on the current price offered across the markets. The farmer is also responsible for sending a message to a buyer, he or she sees and is willing to sell the farm product to. Once a farmer gets in touch with a buyer he or she can negotiate the price with the buyer who is also willing to offer. This serves as another process taking by the farmer.

On the other hand, the buyer first of all sign up with his or her details including the particular product (s) he would like to buy. The buyer's choice is also based on the proximity of the farmer, price, and quality as well. The buyer is also responsible for placing an order when interested in the product offered by the farmer on the platform. Once a buyer gets in touch with a farmer, he or she can negotiate with the price the farmer offers.

4.2 Features

The following describes the various major features of the system:

- Login by the user. The system enables the users to be able login. This ensures authenticity of the system.
- Finding markets for farmers by connecting them directly to the buyers.
- The ability of the farmers to send message to buyers about their product.

- Buyers are able to place an order for the farm produce of their choice. This comes as a result of the detailed information about the farmer given to the buyer on the platform to be able to make informed decisions. Signed buyers can log in with their username and password as well as the product type they want to buy. When they are able to sign up or log in, they are taken to the home page where the product type they want to buy is there. From there they can proceed to any other product page they are interested in.
- Buyers send messages to farmers on the type of farm products they like. This is done through SMS.

These major tasks came as a result of the relevant information the platform provides to both the farmers and buyers. In the platform, the buyers are provided with information about the farmer product (that is its quality), the location of the farmer, price and number of years the farmer has been into farming and the quantity the farmer can offer.

On the other hand, the farmer is fed with information such as the prices in the various markets near and far from him. The system shows the farmer; the buyer, his location, price he or she is willing for the product, the quantity he wants to buy.

The information about the farmers and the buyers were gathered to make the system a better one. The author went to few markets in the Accra Metropolitan Assembly to gather the data about the price and the potential buyers. Farmers' data were collected at their community in Berekuso in the Eastern Region of Ghana.

4.3 Implementation Support

4.3.1 Tools and libraries

The uses of tools and libraries lead to faster way of implementing the application. Hence the following tools and libraries are considered:

PHP: PHP is a scripting language that offers documentation to ease the development of the application. Its formatting is simple and easy to understand by the users.

JAVASCRIPT: JavaScript is another scripting language that offers dynamism to the web pages. It is responsive and allows user requests to be sent via Ajax.

HTML: HTML (Hyper-Text Markup Language) as a markup language is used to design the front end of the FarmerApp. It allows the embedment of CSS, JS and PHP.

CSS: Cascading Style Sheet is the style sheet that offers nice presentation to the HTML. Hence the CSS offers better styling to the front end of the FarmerApp.

AJAX: Ajax allows requests to be sent and responses to be received. It works in conjunction with the JS to make the system dynamically all the time. It helps make the system more and faster responsive.

MYSQL: MYSQL allows the definition and manipulation of the data. As such it uses the delete, update and insert commands to query the database.

Apache Server (Xampp): Xampp serves as localhost of the FarmerApp. It also supports the execution of the database.

Libraries: FPDF library was used to generate graphs, a report in a form of tables.

4.4 Functional requirement testing and results

The FarmerApp employed functional requirement testing to meet its uses. The testing uses the development test that includes three main levels such as component, unit and system testing.

4.4.1 Login Feature

The login feature will allow users who have signed up to be part of the system to sign into without having to sign up again. It will require the username and password.

A function called login is created in the user class. This function would be called using Ajax and JavaScript at the frontend using the Foundation 6 template. The user will then have to provide in with the details (username and password) for authenticity.

The user (both farmer and buyer) are permitted to login to the users' home page and do his or her daily activities using his or her credentials. If the username and password word is correct, then a successful message is displayed otherwise an invalid message such as 'Please enter a valid username or password' would be displayed. The figure below indicates an invalid username or password entered into the system by a user who already have an account.

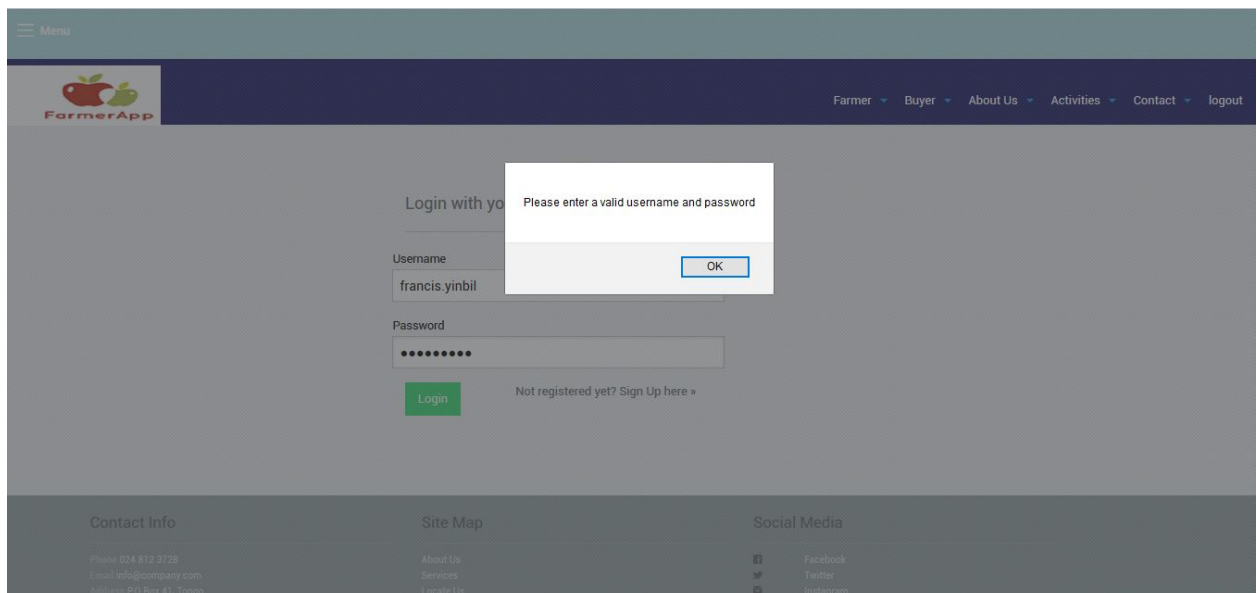


Figure 5.1: Login test with wrong username or password

Test Result

A user who signed in with correct username and password was able to log in or sign in successfully. This indicates that the login feature works. The figure below shows a valid username and password entered by the user who already have an account.

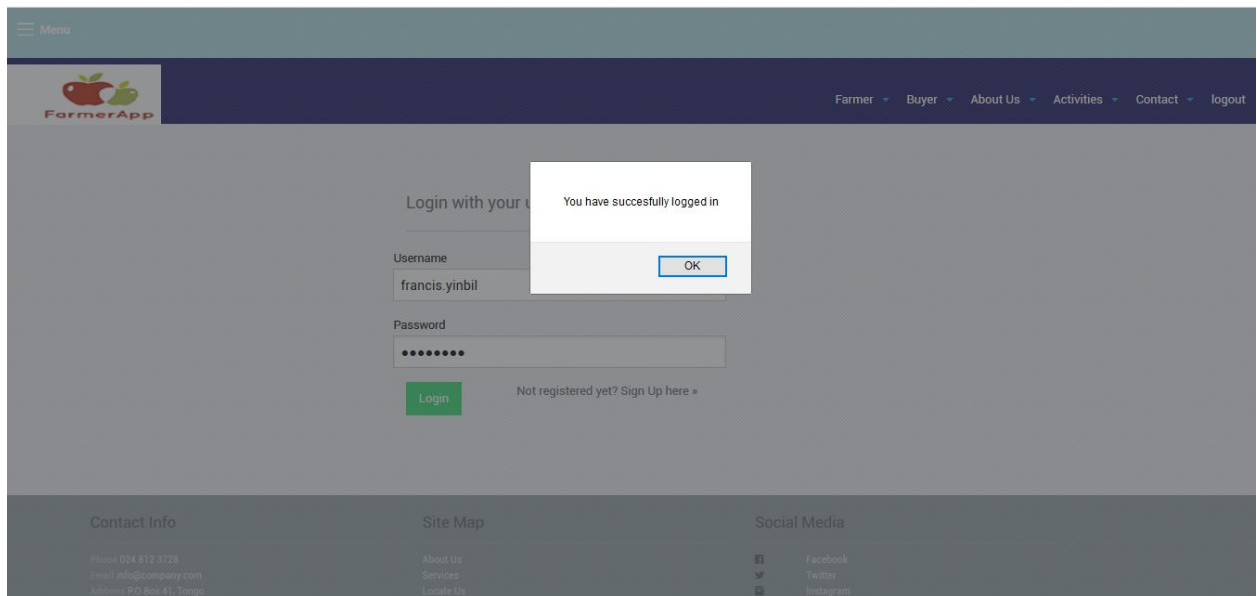


Figure 5.2: Login test with correct username and password

4.4.2 Signup Feature

This feature is meant for the users to sign up as potential buyers. It takes first name, last name, username, email, address, password, and location. The user gets confirmation of successful sign-up and is taken to the buyer index page to look for the product he/she wants from the farmers.

A function page is created first. This page has the sign-up page that enables an easy calling of it in the frontend template using Ajax and JavaScript. All the relevant details will be needed before the user can sign up to be part of the system.

The user should be able to sign up and have access to the buyer index page with the right input fields given him or her. The figure below indicates the interface of the buyer sign up page.

Figure 5.3: Buyer signup interface

Test Result

A successful message is displayed for the user to click okay to be taken to the index page after entering the right details. This indicates that the signup feature works.

4.4.3 Add Farm Product Feature

The add feature allows the farmer who signed up for the first time to upload their products. It also allows the farmer who has already inserted or added the product to continue to add the newest product after every harvest. The input fields include farm type or product name, month planted, month harvested, actual quantity, the location of the farm and image of the product. This information is to help the buyer know much about the farmer in order to place an order for the product.

The add page will be created to allow the users to add their product after signing into the systems with their right details. It will be linked to the home page of the farmers to help them

be able to navigate through the system in order to make an informed decision while uploading it.

The user should be able to add the product and the other relevant details using the input field that is provided for him or her.

Test Result

After creating and testing this function or feature, the user is able to insert or add product to the system using the right inputs given him or her. This indicates that the functionality of the add product feature works properly.

4.4.4 Display/View Farmer Product Feature

The view farmer feature is a feature that enables the administrator to know the number of farmers that are in the system. It also helps the administrator to delete product that was sold the farmer on the platform. It helps the administrator to manage the daily transactions that go on the system.

The administrator should be able to view the number of farmers in the system and with the information about the numbers, he or she can make an informed decision.

Test Result

An administrator was able to view the page as it displayed all the relevant information of the farmers as described above.

4.4.5 Search for product Feature

The search feature is a feature that will enable the buyers of the farm product to quickly search for the farmer and his location. The buyer should be able to search for the farmer and the choice of product at the nearest location. The key words in this search feature will be the location or product desired by the buyer.

A form with the search input field is created to help the user or buyer put in the right details. The form also has the search button and after inputting the keyword or location, the user can click on it to search for the location of the farmer closer to him or her.

The user or potential buyer should be able to search for the location of the farmer closer to him or her or search for the product of their choice and the farmers and their details should be displayed for this buyer to make an informed decision.

Test Result

The user was able to search for farmers in Dome, Kwabenya, and Yendi who are already registered on the platform. Only registered farmers who are in the system can be found as they are those whom the system has their details. After testing it for farmers in Dome and few other places in the system, it indicates that the search feature is working with regards to the location of the farmer closer to the buyer.

The figure below indicates search by location named Dome.

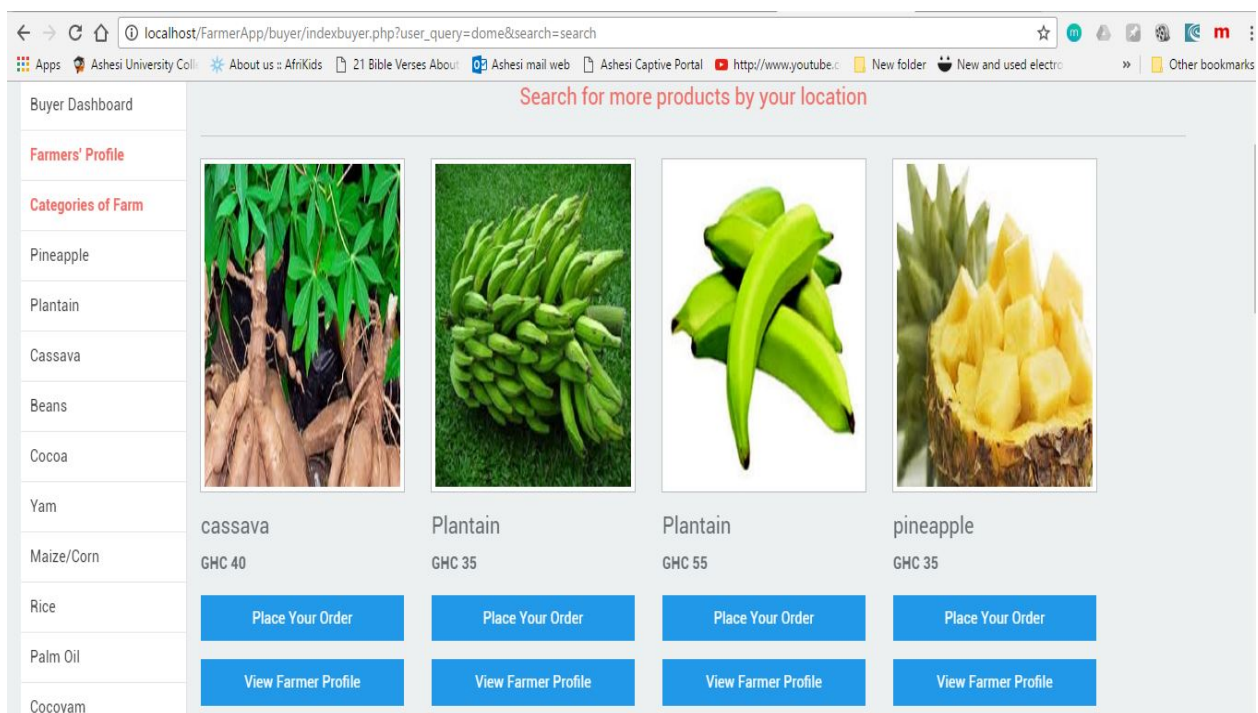


Figure 5.4: Search product by location named Dome

The figure below indicates search by product type of the farmers

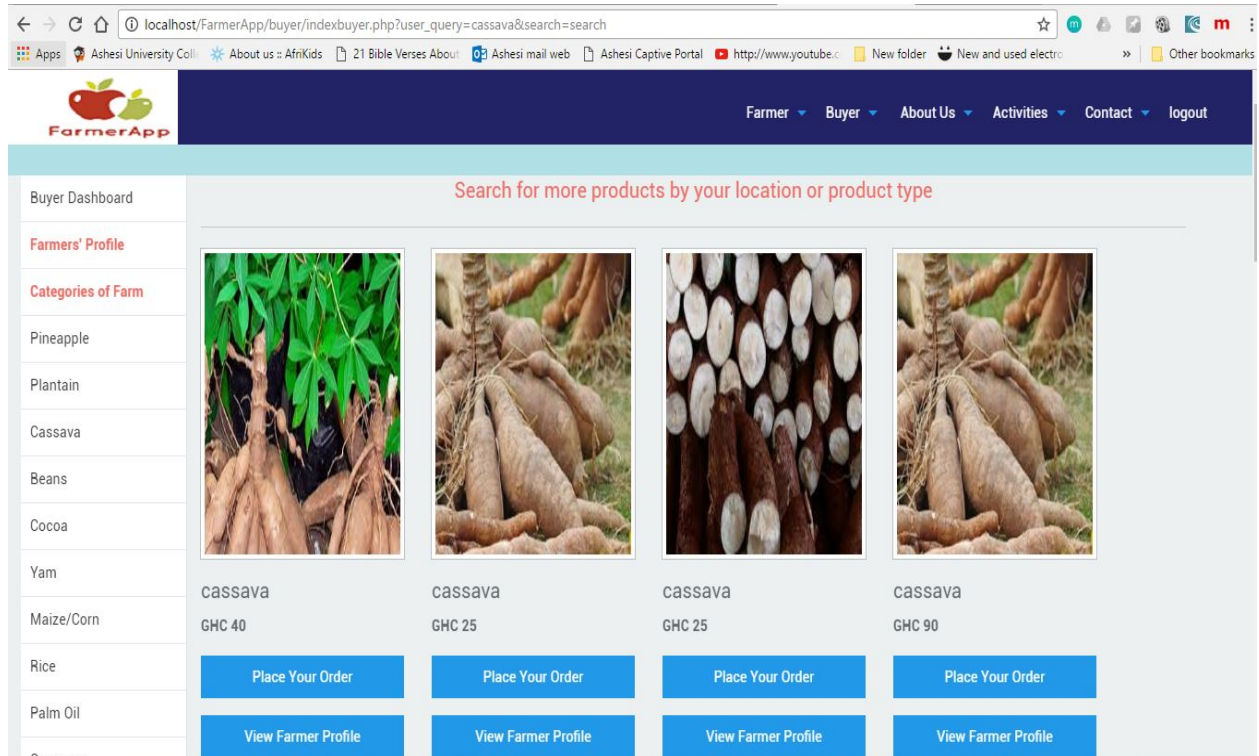


Figure 5.5: Search product by product type named cassava.

4.5 System Testing

The system testing confirms the purpose of the system. It ensures that the system achieves the goal and does what is expected of it. A farmer was asked to sign up with his relevant details such as first name, last name, username, password, address, contact number, his image, product or farm type, the image of the product. After all the user inputs were entered, a submit button was clicked and the system redirected the farmer to the buyer's page based on the product type he uploaded into the system. Direct matching of the farmer to the buyer took place. For instance, a pineapple farmer who signed up with his or her product was taken to the pineapple buyers in the platform.

Chapter 5: Conclusions and Recommendation

5.1 Conclusion

The purpose of the FarmerApp is to increase effectiveness and efficiency in linking farmers to buyers in every farming season. The FarmerApp application permits the buyers and the farmers to meet and transact business based on the unique farm product. The Farmers can use the application to add their personal and farm details. Once the farmers have successfully added their details they are connected to the buyers of their produce.

The farmer can send a message to the buyer who seems to offer a better price for his farm product after comparing various prices from multiple buyers presented in an understandable format on the platform. Besides that, the farmer can view buyers' location and the quantity they want from the farmer. This helps the farmer to make an informed decision about the next production.

The buyers can use the application to add their user details. Once the buyers have successfully insert or add their details they are connected to the farmers who have the product of their choices.

The buyers can send a message to the farmers who seem to offer better prices for the product of their interest and probably might be closed to them. Also, the buyers can view and search for farmers closer to them and can offer the desired quantity. They can also search for the average prices of product in their locality. This helps the buyers to make an informed decision about the farmers who can offer them better services based on the price, location, and quantity as well as the quality of the product.

The FarmerApp system is both web and mobile app. They are allowed multiple operating systems to achieve its goal.

5.2 Limitations

The FarmerApp is limited in a way because only farmers who have smart phones can use it. The farmers who cannot afford or do not know how to use smartphones will miss a lot of its functionality. Farmers who cannot afford to subscribe to the daily message from the buyers who want to buy their products might be limited in one way or the other.

Buyers who cannot afford for smartphones where they can install the application on their phones by downloading from play store will be limited. In like manner, buyers who are not registered in the system cannot receive updates from farmers who have their most recent product for sale at an affordable price.

5.3 Recommendation

The first version of the FarmerApp application has an implementation of the design and functionalities described in the requirement specification. Notwithstanding more work needs to be done to make it a full system and good for usage. An updated version of this application can be implemented to organize a market system that gives the farmers a good quality and market price to help them make an informed decision when deciding on the price of their produce. Also, the system should include all group of farmers both literate and illiterate farmers, farmers in the rural and urban areas.

References

Agriculture . (2016, September 23). Retrieved from Grameen Foundation:

<http://www.grameenfoundation.org/what-we-do/agriculture>

Agriculture in Ghana, Country Brief. (2013, May 14). Retrieved from Agriculture in Ghana:

<http://agricinghana.com/2013/05/14/agriculture-in-ghana-country-brief/>

Baumüller, H. (2015). *Assessing The Role of Mobile Phones in Offering Price Information*.

Germany.

Lightfoot, C., Gilman, H., Scheuermeier, U., & Nyimbo, V. (2008). The First Mile Project in

Tanzania: Linking Smallholder Farmers to Markets Using Modern Communication Technology. *International Mountain Society*, 13-17.

Maputsoe, N. C. (1998, February 22). *Problems of distribution and marketing of agricultural produce; a study of the role of women in the Kumasi Central Market*. Retrieved from

KNUSTSpace: <http://ir.knust.edu.gh/handle/123456789/3034>

Sanginga, P. C., Best, R., Chrisike, C., Delve, R., Kaaria, S., & Kirkby, R. (2004). Linking Smallholder Farmers to Markets in East Africa. Empowering Mountain Communities to Identify Market Opportunities and Develop Rural Agron. *International Mountain Society*, 288-291.

Appendices

Appendix 1

List of Tables and Attributes

Table 2: Farmers' table and attributes

Field Name	Data Type	Other Information	Allow Null	Description
FarmerID	Int	Primary key field	No	Used to uniquely identify a Farmer
FirstName	Varchar	Field length: 50	No	Helps to easily find the Farmer First Name
LastName	Varchar	Field length: 50	No	Helps to easily find the Farmer Last Name
ContactNo	Varchar	Field length: 50	No	Tells the specific contact of the Farmer
Location	Varchar	Field length: 100	No	Tells the specific location of the Farmer
Address	Varchar	Field length: 100	No	Tell the specific address of the Farmer
FarmType	Varchar	Field length: 50		Tell the specific farm type (Example: tomatoes farm, maize farm etc.) of the Farmer

Table 3: Buyers' table and attributes

Field Name	Data Type	Other Information	Allow Null	Description
BuyerID	Varchar	Primary key field	No	Uniquely identify a Buyer
FirstName	Varchar	Field length : 50	No	Helps to easily find the Buyer First Name
LastName	Varchar	Field length : 50	No	Helps to easily find the Buyer Last Name
ContactNo	Varchar	Field length : 50	No	Tells the specific contact of the Buyer
Location	Varchar	Field length : 100	No	Tells the specific location of the Buyer
Address	Varchar	Field length : 100	No	Tell the specific address of the Buyer
BuyerType	Varchar	Field length : 50	No	Tell the specific Buyer type (Example: final consumer, processors, market women etc.) of the Buyer

Table 4: Middlemen table and attributes

Field Name	Data Type	Other Information	Allow Null	Description
MiddlemanID	Varchar	Primary key field	No	Uniquely identify a Farmer
FirstName	Varchar	Field length: 50	No	Helps to find the Farmer First Name
LastName	Varchar	Field length: 50	No	Helps to find the Farmer Last Name
ContactNo	Varchar	Field length: 50	No	Specific contact of the Farmer
Location	Varchar	Field length: 100	No	Specific location of the Farmer
Address	Varchar	Field length: 100	No	Specific address of the Farmer
FarmType	Varchar	Field length: 50	No	Specific farm type (Example: tomatoes farm, maize farm etc.) of the Farmer

Table 5: Farm table and attributes

Field Name	Data Type	Other Information	Allow Null	Description
FarmID	Varchar	Primary key field	No	Uniquely identify a particular Farm
FarmerID	Varchar	Field length: 50	No	Uniquely identify a particular Farmer that owns the farm
FarmLocation	Varchar	Field length: 50	No	Specific location of the Farm
MonthPlanted	Varchar	Field length: 50	No	Specific month the farmer planted
MonthHarvested	Varchar	Field length: 100	No	Specific month the farmer would harvest/harvest
ProductType	Varchar	Field length: 100	No	Specific produce of the Farm
ActualQty	Varchar	Field length: 50	No	Quantity to obtain in that farm

Table 6: Transaction table and attributes

Field Name	Data Type	Other Information	Allow Null	Description
TransactionID	Varchar	Primary key field	No	Uniquely identify a Buyer
FarmID	Varchar	Field length: 50	No	Uniquely identify the farm the farmer had his produce
FarmerID	Varchar	Field length: 50	No	Uniquely identify the farmer doing the transaction
Product	Varchar	Field length: 50	No	The Produce from the farm
ActualQty	Varchar	Field length: 100	No	Tells the specific quantity produce from the farm
QtySold	Varchar	Field length: 100	No	Tell the specific quantity sold
QtyLeft	Varchar	Field length: 50	No	Tell the specific quantity left after selling
Price	Double	Field length: 50	No	Price of the farm produce
Profit	Integer	Field length: 11	No	Profit made from the produce
Loss	Integer	Field length: 11	No	Loss made from the transaction